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Patent Office

(11) (C) 1,282,571

(21) 540,854

(22) 1987/06/29

(45) 1991/04/09

(52) 20-38.1
C.L. CR. 26-73
189-50

(51) INTL.CL.[5] B29C-63/08; B29C-67/14; B29C-67/18

(19)(CA) **CANADIAN PATENT** (12)

(54) Method of and Means for Producing Reinforced Ribbed Structures

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(30) (AU) Australia PH06719 1986/07/03
(AU) Australia PI01267 1987/04/06

(57) 38 Claims

"METHOD OF AND MEANS FOR PRODUCING REINFORCED RIBBED STRUCTURES"

This invention relates to a method of and means for producing reinforced ribbed structures, particularly tubes but has application also to panels, but in particular it relates to structures of the type in which a strip having a series of upstanding ribs on at least one face and interengaging edge means is used.

This form of helically wound tube is already well known and is described in patents by the same Inventor relating both to the form of the strip and the form of the machine by means of which the tubes are produced from such strips.

It is a well established fact that a helical, sometimes referred to as a spiral, tube of a plastics material with a ribbed configuration forms an attractive method of producing low cost tubes for water, sewers and the like.

One problem with such tubes is that because such tubes are made from thermoplastic materials, they have a low modulus of elasticity to the point that to meet the deflection criteria when buried in a trench or subject to high earth loads, such tubes need to have relatively high ribs and a substantial wall thickness.

The object of the present invention is to provide certain improvements to the method of manufacture and the tube itself formed according to this invention

and this improvement is achieved according to this invention by reinforcing members associated with the tube so formed, which reinforcing members may comprise relatively rigid members in strip form or of selected cross section, which reinforcing members locked on to or placed between or embedded in the structure in such a manner that the deflection resistance of such a tubular object is materially increased.

It is of course already known to reinforce tubing, such for instance as used in vacuum lines, by steel springs or the like wound into the wall of the tube during manufacture or associated with the tube after manufacture by embedding the wire spring material or the like in a groove in the material, but the object of the present invention is to stiffen the ribs in at least a generally radial direction, although some lateral stiffening may also be necessary.

It has been found that when a helically wound plastic tube is placed in a trench and backfilled with sand or gravel and a load is applied on top of the backfilled tube, the load can be a wheel of a laden truck or by simply a force from a hydraulic jack on to a steel plate, which in turn deflects the buried test pipe to destruction, the failure mode is one which deforms the crown of the pipe, leaving the rest of the pipe in good order. The particular failure point is when the tube is deformed beyond its elastic limit

the helical seam springs open and the sand backfill under load then quickly flows to the failure point further exaggerating the problem as the 'domino effect' takes over because the ribbed configuration then collapses sideways.

It is an object of the invention to make the joint stronger so that the total tube will have enhanced properties.

One of the problems of course of winding a strip or the like into such a structure, such as by engaging it to be upstanding along the wall of T-shaped ribs or the like, is to be able to achieve the required circular configuration when the face of such material is radially disposed and to still allow the strip to be closely accommodated to the ribs when the strip from which they are formed is bent into a helical formation to form the tube, and the invention therefore is designed so that while withstanding generally radial loads the reinforcing ribbon or the like may be corrugated laterally or so formed that it can be bent to a circular configuration. The invention is however not limited to tubular structures but applies also to panels having a similar rib structure.

The reinforcing member can be locked on to or placed between ribs in such a manner that the member considerably increases the deflection resistance of such objects but instead of using a metal reinforcing member, a strip of fibreglass, saturated with a plastic resin such as epoxy or polyester, may be used.

The steel or other reinforcing member can be encased in a resilient or a plastic sheath to avoid corrosion or absorb shocks, or the reinforcing member may be made from a material such as stainless steel which will not be subject to deterioration by the elements or conditions under which it is used.

The invention thus relates to a method of reinforcing a structure formed by interengaging the edges of plastics strip means to form a helically wound tube or a panel, said strip means comprising a plurality of ribs spaced apart and upstanding from a base of the strip means, characterised by engaging on the strip means a reinforcing member or members, and locking the reinforcing members to the strip means.

The means comprise a structure formed by interengaging the edges of plastics strip means to form a helically wound tube or a panel, the strip means comprising a plurality of ribs spaced apart and upstanding from a base of the strip means, characterised by at least a reinforcing member engaging the strip means, and by means locking the reinforcing member preferably to the strip means.

In order however that the nature of the invention will be fully understood, some embodiments will now be described with reference to the accompanying drawings but the drawings are to be taken as indicating the general principles of the invention and not necessarily to limit the invention to the form shown.

In the drawings;

FIG. 1 is a schematic view showing in perspective ribbed strip means being wound into a tube by overlapping the edges of adjacent convolutions and joining them together by interengaging longitudinally running interengaging members, showing also a reinforcing member being helically wound into the space between the ribs of the strip means,

FIG. 2 is a perspective view of a reinforcing member segment which may be used, a number of these being spaced where required, this form being used when some diameter change of the tube occurs,

FIG. 3 is an enlarged perspective schematic view of the overlapping edges of two convolutions of a strip of plastics material, showing the reinforcing member in place, this view and the following views being in the nature of end elevations of the strip of plastics material and the reinforcing member.

FIGS. 4, 5, 6, 7 and 8 show different forms of reinforcing members to be used, in the case of FIGS. 4, 5 and 8 as reinforcement means between the ribs of the strip means and in the case of FIGS. 6 and 7 as reinforcement means used over the overlapping edge portions of the strip means,

FIG. 9 showing portion of a strip of plastics material showing various of many forms which the reinforcing members can take,

FIG. 10 is an end elevation showing the reinforcing member used as a lateral rib stabilizer by being positioned longitudinally on the ribs of a strip of plastics material,

FIG. 11 shows another form of lateral stabilizer with the reinforcing member overwound on a tube or extending across a panel but at an angle different to the angle of the ribs, and

FIG. 12 shows at A, B and C, how a reinforcing member, shown in perspective, can be formed to assist winding of the strip into tubular form.

It is to be stressed that the forms illustrated are exemplary only of many forms of reinforcing members which can be used.

In the following description similar integers in each figure will be given the same reference numerals but where necessary differences will be indicated by further reference numerals.

Referring first to Fig. 1, the ribbed strip means 1, formed from a plastics material, has upstanding ribs 2 on one face and has at one edge 3 a longitudinally running barb 4 adapted to engage a longitudinal socket 5 at the other edge 6 of the strip, each rib 2 having an expanded end 7, the edge 6 having a locking tail 8 projecting from its extremity as shown more particularly in Fig. 3. The tube is designated 9.

Referring first to the configuration of the reinforcing member 10 shown in Fig. 4, this comprises a metal or fibreglass strip 11 of U-shaped section with its side members 12 slightly splayed outwardly and these side members 12 may be corrugated as shown in Fig. 12A, this reinforcing member 10 being inserted between any of the ribs 2 which form part of the profile of the strip 1 which creates a tubular or planar object, the reinforcing members 10 being located between the ribs 2 of a helically wound tube or a panel being formed, or shorter sections may be used where an elongated reinforcing member is not required, the non-planar cross-section giving strength.

In this way a simple reinforcing member 10 can be positioned generally vertically between the upstanding ribs 2 which form part of the profile which is used to create such tubular or planar objects. It will be seen that the reinforcing member 10 generally extends across the space between the ribs 2 to be held between the ribs 2.

In the case of a tube 9, the reinforcing member 10, because of its configuration, not only holds the helical seam of the tube together but also adds to the deflection strength of the finished tube.

As shown in Fig. 2, the reinforcing member 10, instead of following the elongated helical path around the tube 9, may be made in sections of a length such that each section extends around the tube 9 with its edges overlapping a sufficient distance to provide a band 13 extending around the tube 9 to resist compression of the tube, but with the two ends 14 being free to move longitudinally in the spaces between the ribs 2 so that when compressed, the reinforcing member 10 as well as the tube 9 can temporarily be changed in diameter by the end portions 14 of the reinforcing member 10 moving the one relative to the other, but can then spring back to the original shape, where this is not required the helical reinforcing member 10 extends over substantial distances of the tube.

Instead of using the shorter sections of helically shaped bands 13 as the reinforcing members 10, the reinforcing member 10 can be continuous, but may be provided with transverse corrugations 15 at appropriate localities as shown in Fig. 1 which allow the metal reinforcing to adjust to changes in diameter of the tube when under pressure, and it will be realised that this transverse corrugation can extend the full length of the reinforcing member or can be applied at discrete intervals along its length.

The reinforcing member 10, when of "U" shape as described, is proportioned to have the somewhat outturned side members 12 of the strip 11, which forms

the reinforcing member 10, being engaged underneath the expanded ends 7 of "T" shaped ribs 2.

Referring now to the form shown in Fig. 4 the two overlapping edges 3 and 6 of the ribbed plastics strip means 1, whether helically wound or in the form of a panel, are shown with an interengaging lock 16 of generally approved and presently used design, the one edge 6 having the socket 5 which is engaged by a complementary barb 4 on the other edge 3 and including a tail 8 projecting from the socket 5 to engage beneath the next rib 2 in the series to form an effective lock.

The reinforcing strip 10, which has two side members 12, is positioned in the cavity between a pair of adjacent ribs 2 with the edges of the side members 12 engaged beneath the expanded ends 7 of the ribs 2 to firstly lock the reinforcing strip 10 in position between the ribs 2 and secondly to maintain the spacing of the ribs 2 under load where for instance the outer ends of the ribs may tend to be deflected laterally.

Fig. 5 shows a configuration of a strip of plastics material similar to that shown in Fig. 4 but the locking tail 8 is omitted, side members 12 of the reinforcing members 10 engaging the socket 5 of the join to prevent withdrawal of the barb 4 from the socket 5 at the lock 16 of the adjacent edges of the strip means 1.

In Fig. 6 is again shown a similar configuration of a strip of plastics material to that illustrated with reference to Fig. 4 but in this case the reinforcing member 10 is in the nature of a strip 19 shown as spanning the join formed by the socket 5 and barb 4, the central portion of a strip 19 being shaped to lock the barb 4 and socket 5 together when it has been applied, the central portion 19 having extensions 20 which terminate in angularly disposed tails 21 which engage beneath the expanded portions of the two adjacent ribs 2 to thus form a firm lock at the join but because of its shape also ensuring that the strength of the join under load is greatly enhanced.

This reinforcing member 10 can be wound over, for instance, a pipe 9 as it is being formed or it can be locked in place when a series of strip means 1 are used to form a panel to enhance the strength of the structure as well as making the join stronger and more effective.

Fig. 6 is a compound view showing remote of the just described reinforcing member 10 a modified form of reinforcing member 10 in which the strip 22 is of arcuate form which can be clipped into the hollow between a pair of ribs 2, the strip 22 in this case having on its underside a resilient pad 23 which can be attached to the strip 22 or can be separately wound into the hollow between the ribs 2 before the

strip 22 is applied the purpose of this being to still have the aligning effect on the ribs 2 when a series of these reinforcing strips 22 are placed adjacently along the length of a tube 9 or panel but serving also as cushioning means by distributing load directed on to them by, for instance, earth when they are embedded so that the earth stress is transmitted through the resilient pad 23 to the base 24 of the plastic ribbed strip 1.

Fig. 7 shows a modification of the reinforcing member 10 shown in Fig. 6, the strip 19 which forms the reinforcing member 10 in this case having a pair of channel shaped members 25 which engage over the expanded ends 7 of two adjacent ribs 2 and have the portion 26 between the ribs extending down to engage the locking tail 8 of the ribbed plastics strip 1 and force it tightly into its locked position, the two end walls 27 extending towards the base and again, as in Fig. 6, the one channel shaped member 25 locks the barb 4 and socket 5 firmly together when applied.

Any number of ribs can be engaged by the reinforcing member 10 by laterally extending the width of the strip in a shape as generally defined. The dotted lines show also how the ends of the strip 19 can be extended to engage beneath the expanded ends 7 of the ribs 2.

Fig. 8 shows a further modification in which the reinforcing member 10 is in the nature of an open tube 29 but shaped to give a flat surface 30 at the expanded ends 7 of the ribs 2 by fitting between the expanded ends 7 and locking by reason of the locking means 31, the walls of the tube extending down at 32 to press onto the base of the plastic ribbed strip means 1, these members as shown being opened at 33 to allow some flexing during insertion between the ribs 2 but where such a strip is progressively applied helically along, for instance, a tube or progressively applied along a panel, the ribs 2 can distort to allow the reinforcing member 10 to be positioned but when the next reinforcing member 10 continues to be applied at the next convolution the reinforcing strip 10 is maintained in firm position between the expanded portions 7 of the ribs 2 between which it is fitted.

Fig. 9 is a compound view giving some idea of various shapes which can be used for the reinforcing member 10 and these are described from left to right as shown in Fig. 9, the first reinforcing strip 10 comprising a tube 35 with locking means 36 engaging the expanded portions 7 of the ribs 2 and with the space defined between the reinforcing member 10 and the ribs 2 and the base 24 filled with a resilient or sealing member 37 which can be pre-applied to the channel between the ribs or can be injected into the space between the tube 35 and the strip means 1 of plastics material after the reinforcing member 10 is positioned.

The next reinforcing member consists of a tubular strength member 38 which may be formed of steel or fibreglass or the like and is surrounded by a tubular sheath 39 which can be of circular shape as shown but could have other configuration, but by using a tubular sheath 39 which embeds the strength member 38 it is possible to force the reinforcing member 10 into position by continuously winding, such as when forming a helically wound tube, or by placing into position in the case of a panel, or such members can, as is the case with the first embodiment, be applied only at selected locations where stress considerations of sealing make it desirable to use this reinforcing strip.

In the next form shown in Fig. 9 the reinforcing member 10 comprises a resilient member 40 shaped to be locked into a cavity between a pair of ribs 2 but having moulded into it a metal or fibreglass or other strength member 41 which can be corrugated longitudinally in the resilient member 40 so that the reinforcing member 10 can be readily wound into position in the case of a helically wound tube. Obviously the strength member 41 can have other forms than that shown.

In the fourth embodiment shown in Fig. 9 the reinforcing member 10 comprises a filler member 42 which can be held in place by a resilient loading member 43 which pushes the filler member 42 outward to have locking members 44 rigidly engage the edges of the expanded portions 7 of the ribs 2.

In the form shown in Fig. 10 the plastic ribbed strip 1 is similar to the form shown in Fig. 4 but in this case the reinforcing member 10 comprises a planar strip 45 which is shaped to engage the expanded ends 7 of the ribs 2 and hold them at correct spacing, one in relation to the other, the strip 45 being shaped to have side walls 47 which engage the expanded portions 7 of the ribs 2 with the ends 48 preferably bent to partly encircle the expanded portions 7 of the ribs 2 to achieve a firm lock.

It would of course be possible to extend the planar member down at the location of the join to hold the join in position after application as with the shape used for instance to reinforce the join in Figs. 6 and 7 and a series of these strips could be used side by side and interengaged at the edges to form a double-walled tube. The dotted lines show how the planar strip 45 can extend laterally to form a cladding for the ribbed strip means 1.

In all the foregoing described embodiments the reinforcing member 10 extends longitudinally in relation to the ribs 2 but in Fig. 11 is illustrated how the reinforcing member or members can be overlaid.

In this form the reinforcing member 10 is in the form of a channel-shaped reinforcing strip 50 positioned to extend angularly over the ribs 2, but the side

walls 51 of the strip 50 are engaged in the expanded ends 7 of the ribs 2, these side walls 51 being applied by shaping them so that they can be forced into the plastic expanded ends 7, or they can be applied by moving the tube 9 when formed through a machine which forms slots at their appropriate locations in the expanded ends 7 of the ribs 2 and presses the side walls 51 into position to firmly engage with the expanded ends 7 of the ribs 2.

Instead of using channel shaped strips 50 as the reinforcing members 10, these could be of "T" shape with a web 52 extending down into the rib 2 of the strip of plastics material and such a configuration is shown dotted in the left hand side reinforcing member 10 of Fig. 11, the downwardly extending web 52 being either slitted or corrugated if necessary to allow it to be effectively wound into position when used on a tube as shown for instance in Fig. 12.

Fig. 12 shows a reinforcing member 10 similar to that used in Fig. 4, but showing at A how the walls of the member can have corrugations 54 formed in them to allow the reinforcing member 10 to be more readily bent into a curved form such as when using it on a tube as 9.

At B of Fig. 12 is shown how the walls of the reinforcing member 10 can have slits 55 to allow the required curvature to be readily attained. C of Fig. 12 showing how the slits 55 can be formed from the opposite direction to again facilitate the curving of the strip.

The method of application of the reinforcing member 10 can vary but may be as shown in Figs. 1 and 3 where the strip of plastics material 1 is fed between driven joining rollers 60 and 61 to interlock two edge portions of the convolutions of the strip 1 of plastics material, the reinforcing member 10 being fed on to the strip 1 and pressed into position by the rollers 60 and 61. The reinforcing member 10 can be fed continually or at required intervals and may be positioned between ribs or over the join formed at the contiguous edges.

It will be obvious that other forms which facilitate bending of the reinforcing member 10 can be used, and it will also be appreciated that such configurations as shown in Fig. 12 or extensions thereof can be applied to any of the other forms of reinforcing member illustrated herein.

It is also clear that the ends of the ribs 2 need not necessarily be expanded as indicated by 7 as the reinforcing member 10 can be located between the ribs by tension in the case of helically wound tubes or by being located by notches or other configuration in tubes or panels.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. The method of reinforcing a structure formed by interengaging the edges of ribbed strip means (1) formed of a plastics material to form a helically wound tube or a panel, said strip means (1) comprising a plurality of ribs (2) spaced apart and upstanding from a base (24) of the strip means (1), characterised by engaging on the strip means (1) a reinforcing member (10), and locking the said reinforcing member (10) to the strip means.

2. The method of claim 1 characterised by engaging the reinforcing member (10) on or in an expanded outer end (7) of a rib (2).

3. The method of claim 1 characterised in that the reinforcing member (10) extends around at least one convolution of the ribbed strip means (1).

4. The method of claim 1 when used to reinforce a tube (9) formed by helically winding the ribbed strip means (1) to overlap a join (16) between the edges of adjacent convolutions of the said ribbed strip means (1), characterised by winding the reinforcing member (10) into spaces between the ribs (2) of the ribbed strip means (1) and locking the said reinforcing member (10) to the said ribbed strip means (1).

5. The method of claim 1 when applied to a panel characterised in that a series of said ribbed strip means (1) are placed contiguously, joining the longitudinal edges of the ribbed strip means (1) together, and inserting reinforcing members (10) into spaces between selected ribs (2).

6. The method of claim 4 characterised in that the said reinforcing member (10) is pressed over a rib (2) which forms the joining means (16) between the edges of the ribbed strip means (1), and locking the said reinforcing member (10) over the said rib (2) which forms the joining means to further secure the said join.

7. The method of claim 1 characterised by feeding ribbed strip means (1) between joining rollers (60-61) to form a tube and to lock the edges of adjacent convolutions of the ribbed strip means (1) together, and feeding the reinforcing member (10) between the said joining rollers (60-61) to engage the said reinforcing member (10) at least between the ribs (2) of the ribbed strip means (1).

8. The method of claim 7 characterised by continuously feeding at least a reinforcing member (10) to between adjacent ribs (2) of the ribbed strip means (1) as the ribbed strip means (1) are wound into a tube (9) to helically wind the said reinforcing member (10) on to the helically wound tube (9) so formed.

9. The method of claim 7 characterised by intermittently feeding at least a reinforcing member (10) to between adjacent ribs (2) of the ribbed strip means (1) as the ribbed strip means (1) are wound into a tube to helically wind the said reinforcing member (10) on to the helically wound tube so formed.

10. The method of claim 1 characterised by winding the ribbed strip means (1) helically to form a tube (9), interengaging edge portions (3,6) of the convolutions of the ribbed strip means (1) to form a join (16) between convolutions, and applying a reinforcing member (10) over the said join (16) to reinforce the said join (16).

11. The method of claim 10 characterised by applying the reinforcing member (10) to a rib (2) of the ribbed strip means (1) which forms the join (16) and causing the said reinforcing member (10) to extend at least to between adjacent ribs (2) of the said ribbed strip means (1) to reinforce the said join (16).

12. The method of claim 1 characterised by interengaging ribbed strip means (1) by engaging a barb (4) at one edge portion (3) of the ribbed strip means (1) with a socket (5) at an opposite edge portion (6) of the said ribbed strip means (1) to form a join (16), and engaging at least a reinforcing member (10) on at least a rib (2) of the ribbed strip means (1) to extend into the space between the engaged rib (2) and at least the adjacent ribs (2) of the ribbed strip means (1).

13. The method of claim 12 characterised in that the engaged rib (2) forms the said socket (5) of the join (16), and positioning the said reinforcing member (10) to press the said socket (5) on to the said barb (4) to lock the join (16).

14. The method of claim 12 characterised by positioning the said reinforcing member (10) to engage a plurality of ribs (2) to form spacing means for the said ribs (2).

15. An improved structure formed of ribbed strip means (1) comprising a base (24) having on it a series of spaced apart upstanding ribs (2) optionally having expanded end portions (7), characterised by at least a reinforcing member (10) engaging the ribbed strip means to stabilize and locate at least portions of adjacent ribs (2) relative to each other whereby to increase strength of the structure so formed.

16. An improved structure according to claim 15 characterised in that the said reinforcing member (10) is interposed between the ribs (2) at least at intervals.

17. An improved structure according to claim 15 characterised in that the said reinforcing member (10) is interposed between expanded end portions (7) at least at intervals and comprises a strip (11) of non-planar cross-section having its ends engage the said ribs (2).

18. An improved structure according to claim 17, characterised in that the reinforcing members (10) are outwardly opening U-shaped strips (11) engaging the base (24) and having their outer edges engaged beneath expanded end portions (7) of ribs (2).

19. An improved structure according to claim 18 characterised in that the strips (11) which form the reinforcing members (10) are formed of metal and are resilient whereby to apply pressure to the ribs (2) at expanded end portions (7) of the ribs (2).

20. An improved structure according to claim 19 characterised in that the reinforcing members (10) are of inverted U-shape cross-section to span a channel defined between ribs (2) and expanded end portions (7) thereof, and have their edges engaging the base (24) of the ribbed strip means (1).

21. An improved structure according to claim 20 characterised in that the reinforcing members (10) are co-extensive with selected channels formed between the ribs (2).

22. An improved structure according to claim 19 characterised in that at least an expanded end portion (7) of a rib (2) is engaged by the reinforcing means (10), the said reinforcing means (10) comprising a strip (19) having a central portion engaged over the expanded portions (7) and the strip (19) extending down over the rib (2) to terminate in a channel formed between the ribs (2).

23. An improved structure according to claim 22 further characterised in that the membrane strip (19) which forms the reinforcing member (10) is engaged over a rib (2) which includes a socket (5) engaging a barb (4) at overlapping edges (3,6) of the ribbed strip means (1).

24. An improved structure according to claim 23 characterised by extensions (20-21) at the ends of the strip (19) which extend outwards from the socket (5) and engage the base (24) of the ribbed strip means (1) and engage beneath expanded ends (7) on the ends of ribs (2) adjacent to the socket-forming rib (2).

25. An improved structure according to claim 15 characterised by at least a reinforcing member (10) consisting of a strip (22) curved in cross-section and having its edges engaged beneath expanded end portions (7) of the ribs (2).

26. An improved structure according to claim 25 characterised by a pad (23) between the strips (22) and at least the base (24) of the ribbed strip means (1).

27. An improved structure according to claim 15 characterised in that the reinforcing member (10) comprises a strip (19) having at least a pair of channel-shaped members (25) spaced to engage over adjacent ribs (2), at least one portion (26) between the ribs (2) of each channel-shaped member (25) extending down into the channel formed between the ribs (2).

28. An improved structure according to claim 15 characterised in that one channel-shaped member (25) is positioned over a rib (2) which forms joining means (16) between two adjacent edges (3,6) of the ribbed strip means (1) and another channel-shaped member (25) is positioned over an adjacent rib (2), further characterised in that at least portion (26) of the strip (19) between the channel-shaped members (25) engages and locks the tail (8) to the ribbed strip means (1).

29. An improved structure according to claim 15 characterised in that the reinforcing members (10) is a strip (29) formed to have a portion (30) extend between the expanded ends (7) of adjacent ribs (2) and has down-turned portions (32) which engage the base (24) of the ribbed strip means (1).

30. An improved structure according to claim 15 characterised in that the reinforcing member (10) is formed of a tube (35) shaped to fit into a channel between adjacent ribs (2) and to lock to the said ribs (2) by locking means (36) and by resilient means (37) in the space between the ribs (2) and the base (24) of the ribbed strip means (1).

31. An improved structure according to claim 15 characterised in that the reinforcing member (10) comprises a strength member (38,41) embedded in a

resilient sheath (39,40) and in that the resilient sheath (39,40) engages at least the base (24) of the ribbed strip means (1) between adjacent ribs (2).

32. An improved structure according to claim 15 characterised in that the reinforcing member (10) is a filler member (42) disposed between and engaged by the outer end portions (7) of adjacent ribs (2), and by a resilient loading member (43) between the filler member (42) and at least the base (24) of the ribbed strip means (1).

33. An improved structure according to claim 15 characterised in that the reinforcing member (10) comprises a strip (45) engaging the ends of a plurality of ribs (2) to extend over the ribs (2) and having side walls (47) engaging the ends of the ribs (2) to form joining means for the ribs (2) at least at the ends of the ribs (2).

34. An improved structure according to claim 15 characterised in that at least a reinforcing member (10) in the form of a strip (50) extends over a plurality of ribs (2) at an angle to the direction of the ribs.

35. An improved structure according to claim 34 characterised in that the strip (50) is channel shaped and has the side walls (51) of the strip lock to at least the ends of the ribs (2).

36. An improved structure according to any one of preceding claims 15 to 35 wherein at least part of the cross-section of the reinforcing member (10) is generally transversely corrugated or slitted to allow the reinforcing member to curve.

37. An improved structure comprising a tube (9) formed by helically winding a strip (1) of a plastics material having spaced upstanding ribs (2) on at least one face of a base (24) and joining means (4,5) at the edges of convolutions, characterised by at least a reinforcing member (10) engaged on a plurality of the said ribs and would around at least part of the tube (9) to extend into spaces between the said ribs to stabilize the ribs (2) and reinforce the tube (9) against applied loads.

38. An improved structure comprising a panel formed by joining together a series of strips (1) of a plastics material, each strip (1) having spaced upstanding ribs (2) on at least one face of a base (24), and joining means at contiguous edges, characterised by at least a reinforcing member (10) engaged on a plurality of the said ribs to extend over the said structure to stabilize the said ribs (2) and reinforce the panel against applied loads.

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ABSTRACT

The method of and means for reinforcing a structure formed by interengaging the edges of ribbed strip means (1) formed of a plastics material to form a helically wound tube or a panel, the strip means (1) comprising a plurality of ribs (2) spaced apart and upstanding from a base (24), characterised by engaging on the strip means (1) a non-planar reinforcing member (10), and locking the reinforcing member (10) to the strip means to form an attached strength member particularly to attain lateral stability of the ribs.

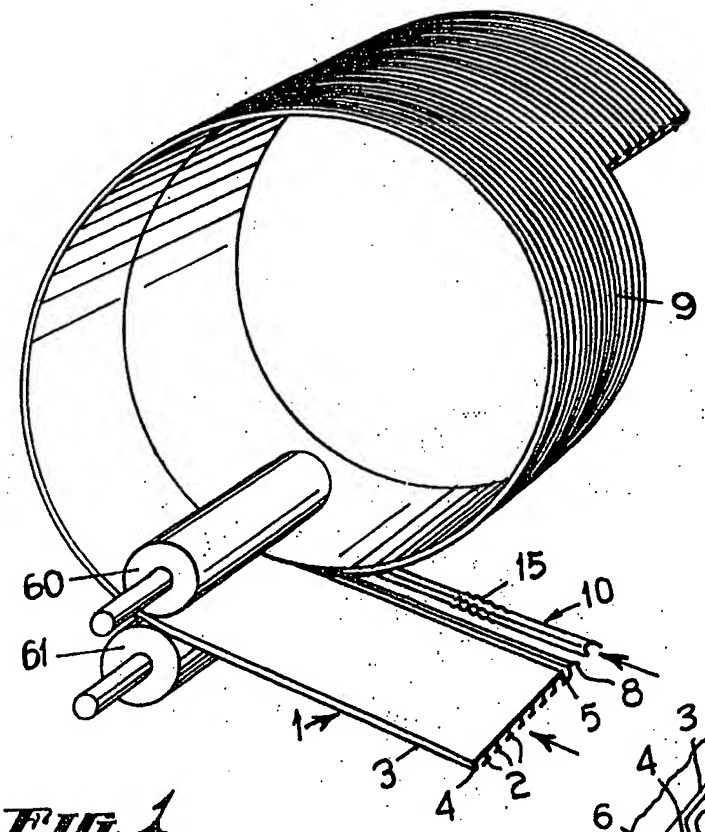

FIG. 1

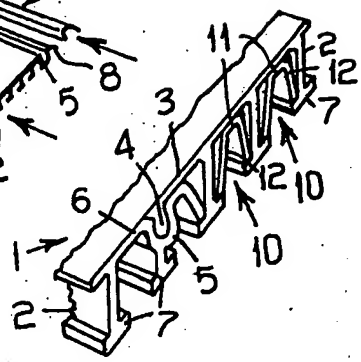

FIG. 3

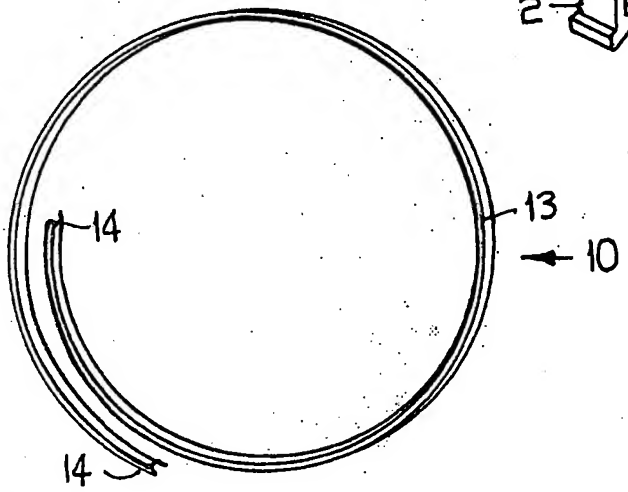

FIG. 2

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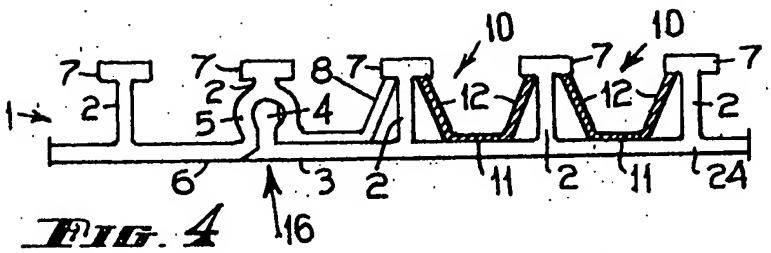

FIG. 4

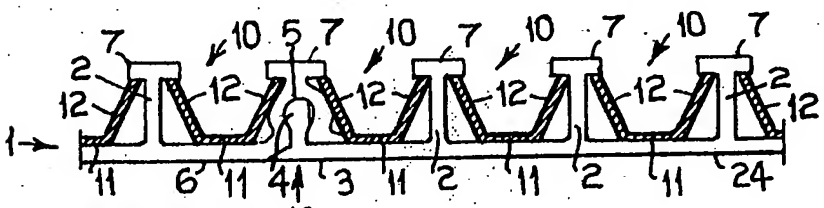

FIG. 5

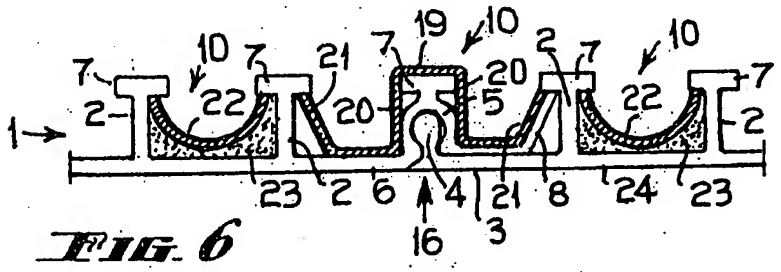

FIG. 6

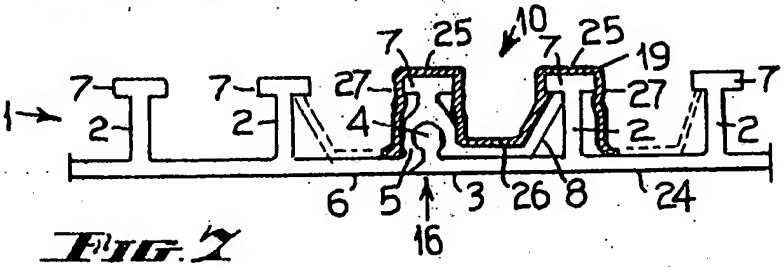

FIG. 7

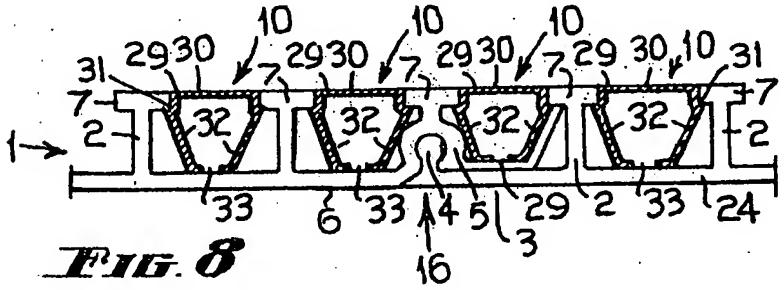

FIG. 8

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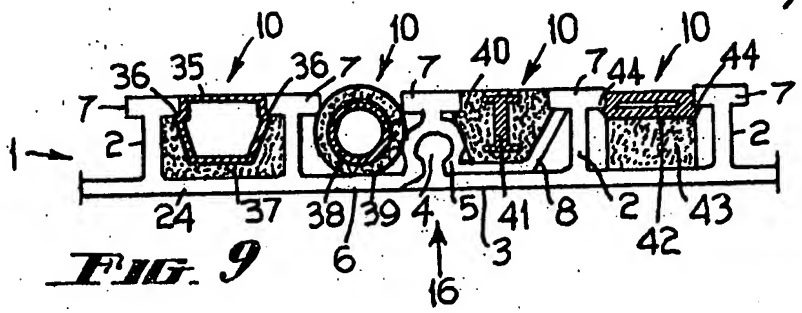

FIG. 9

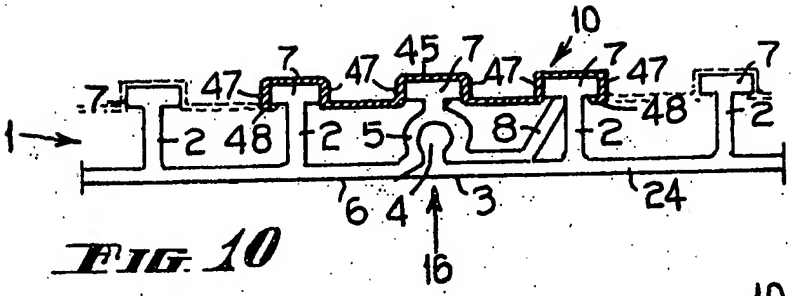

FIG. 10

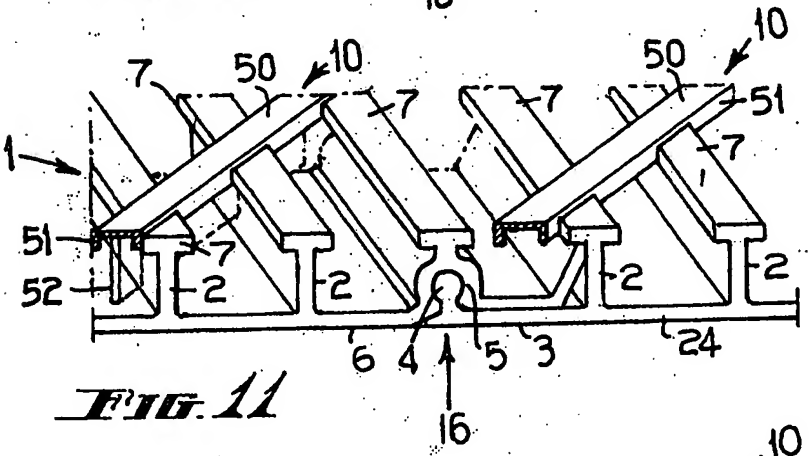

FIG. 11

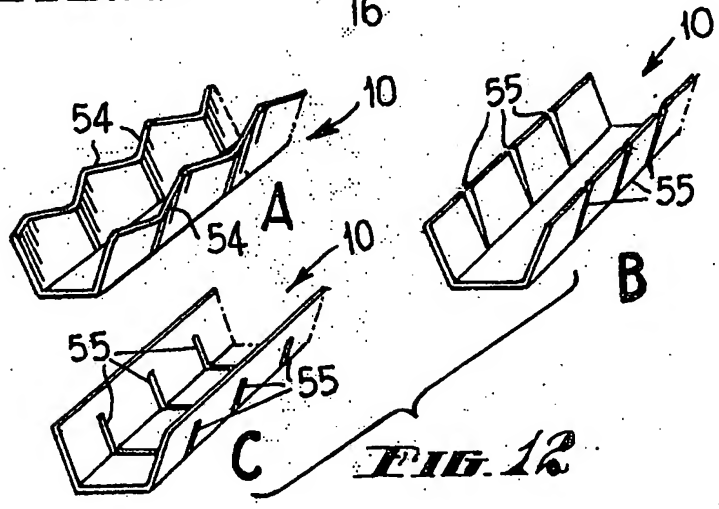

FIG. 12

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